



ON THE FREQUENCY OF FIELD GALACTIC Be STARS

Juan Zorec, Yves Fremat

► To cite this version:

Juan Zorec, Yves Fremat. ON THE FREQUENCY OF FIELD GALACTIC Be STARS. Societe Francaise d'Astronomie et d'Astrophysique, 2005, France. hal-00008526

HAL Id: hal-00008526

<https://hal.science/hal-00008526>

Submitted on 7 Sep 2005

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

ON THE FREQUENCY OF FIELD GALACTIC BE STARS

Zorec, J.¹ and Frémat, Y.²

Abstract. Since Be stars belong to the high velocity tail of a single B star velocity distribution, the appearance of the Be phenomenon must be independent of the stellar mass. In the present paper we show that the shape of the distribution of the number fraction $N(\text{Be})/N(\text{Be+B})$ against the spectral type can be explained in terms of the Balmer line emission efficiency as a function of the effective temperature.

1 Introduction

Field Be stars near the Sun represent a sample of objects in different stages of the main sequence evolutionary phase (MS). Several hypothesis have been put forward to explain the distribution of the frequency of Be stars against the spectral type. As Be stars belong to the high velocity tail of a single B star velocity distribution (Zorec et al. 2005, Martayan et. al. 2005), there is no physical reason that the fraction of Be stars be mass-dependent as apparently it comes up from statistics.

2 Method

In this contribution we show that the observed distribution of the frequency of Be stars is determined by the Balmer line emission efficiency as a function of the effective temperature. The probability of detecting a Be star can be written as:

$$dN(\text{Be}, i) \propto P_{\text{Be}} E_{H\alpha}(T_{\text{eff}}, \tau, i) \phi(\tau) N(T_{\text{eff}}) \sin i d\tau di \quad (2.1)$$

where P_{Be} is the probability that a B star becomes Be; $E_{H\alpha}$ is the average intensity of the $H\alpha$ emission produced by a circumstellar disc of opacity τ in the center of the $H\alpha$ line seen under an aspect angle i ; $\phi(\tau)$ is the probability the disc had an opacity τ ; $N(T_{\text{eff}})$ is the total number of stars having effective temperature T_{eff} ; $\sin i$ is the probability of seeing the disc at an inclination i . The emission intensity factor is $E_{H\alpha}(T_{\text{eff}}, \tau, i) = S_{H\alpha} \Delta(i) (1 - e^{-\frac{\tau}{\cos i}})$, where $S_{H\alpha}(T_{\text{eff}})$ is the

¹ Institut d'Astrophysique de Paris, UMR7095 CNRS, Université Pierre & Marie Curie

² Royal Observatory of Belgium

photoionization-, thus, T_{eff} -dominated $\text{H}\alpha$ line source function; $\Delta(i)$ contains geometrical parameters of the disc, which we assume be the same for all stars. The expected number of Be $N(\text{Be})$ is then given by $N(\text{Be}) = \beta F(T_{\text{eff}}, \tau_o) N(B + \text{Be})$, where $N(B + \text{Be})$ is the number of all stars in the studied mass or T_{eff} interval. Since we assume $P_{\text{Be}}(M) = \text{constant}$, it comes up that $\beta = \text{constant}$ which implies the number of expected Be stars in a given mass range is not mass-dependent.

3 Results and Conclusions

Figure 1a shows $\overline{E(T_{\text{eff}}, \tau)}$ against T_{eff} and τ_o . To represent $N(M)$ we used the total counts of B and Be stars per mass interval in the $V = 7$ magnitude limited volume around the Sun, so as to reflect closely the local IMF. Figure 1b shows the histogram of the observed fractions of Be stars and the histogram predicted by (2.1) with $\tau_o = 1$. Distributions resemble each other closely and maxima at B2 and from B7/8 are well accounted for. The maximum at B2 is due to the high $\text{H}\alpha$ emission, while that at B7/8 is due to the increase of the IMF function. The slight excess of predicted Be stars in the cool extreme of the distribution can be due to stars that have not yet developed the Be phenomenon and to actual Be stars with too tiny or cool discs whose emission has remained unseen. There is enough fast rotating B stars, called Bn stars, which can fit the excess predicted in the low temperature side (Zorec 2004).

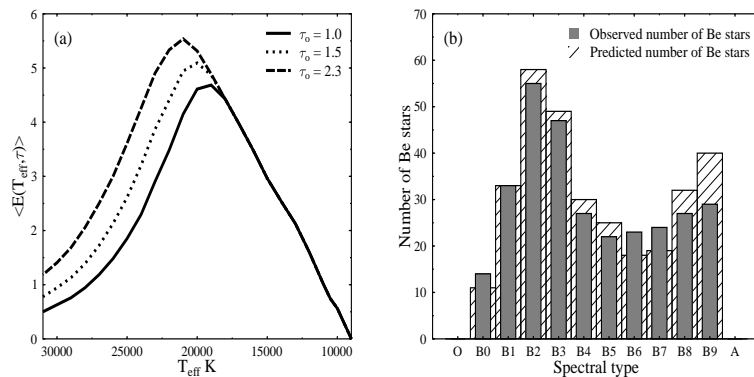


Fig. 1. (a): Emission intensity function in the $\text{H}\alpha$ line as a function of T_{eff} and τ_o . (b) Observed and predicted number of Be stars

References

- Martayan, C., Zorec, J., Frémat, Y. et al. 2005, SF2A/2005, this issue
 Zorec J., Martayan, C., Frémat, Y. et al. 2005, in: Active OB-Stars: Laboratories for
 Stellar and Circumstellar Physics, Workshop
 Zorec J. 2004, in: Stellar Rotation, IAU Symp. No 215, p. 73